Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters	)	IB Docket No. 16-408
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COMMENTS OF SES S.A. AND O3B LIMITED

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SUMMARY

SES and its subsidiary O3b commend the Commission for facilitating the deployment of fixed-satellite service ("FSS") systems by allocating additional spectrum for use by both non-geostationary-satellite orbit ("NGSO") and geostationary-satellite orbit ("GSO") FSS systems. FSS networks are critical to ensuring that U.S. customers have adequate access to broadband service and will be an essential component of future networks, including Fifth Generation ("5G") mobile networks. By formally authorizing GSO FSS and NGSO FSS systems to use spectrum that has previously been allowed only via waiver, the Commission's proposals provide O3b, SES, and other satellite industry participants with the certainty needed to continue their investments in multibillion dollar networks that support a variety of new services and advanced functionalities.

Accordingly, SES and O3b urge the Commission to adopt its proposals to add FSS spectrum allocations in the 17.8-20.2 GHz and 29.3-29.5 GHz bands, subject to appropriate technical limitations and other modifications described herein. The Companies also propose further expansion of FSS use of the 19.3-19.7 GHz and 29.1-29.5 GHz bands given the very limited usage to date, such as through an additional FSS allocation in the 19.4-19.6 GHz and 29.1-29.3 GHz bands to maximize use of spectrum that is not currently being used by any NGSO mobile satellite service feeder link operators. To preserve service continuity for NGSO FSS systems, the Companies also urge the Commission to require later NGSO FSS applicants seeking Ka-band spectrum to protect all previously licensed NGSO FSS systems during any in-line event. In addition, the Companies support the elimination of the global coverage requirement currently contained in Sections 25.145(c)(1) and 25.146(i)(2) of the Commission's rules.

The Companies request that the Commission consider modifying its milestone proposal for NGSO systems in order to better reflect economic realities and foster greater investment, satellite deployment and competition. Specifically, the Companies recommend requiring NGSO systems to launch and operate thirty-three percent of the authorized constellation within six years of authorization with at least one operational satellite in each orbital plane of the authorized system. Once the first milestone is met, licensees must launch and operate seventy-five percent of the authorized constellation with at least one satellite operational in each orbital plane of the authorized system at nine years after the license grant. Finally, the Companies urge the Commission to fully consider all stakeholder services when developing sharing solutions in the Ka-Band.

The Commission should move forward with its proposals to expand spectrum access for satellites and promote greater and more flexible use of spectrum resources. By adopting the recommendations of O3b and SES, the Commission can better encourage continued innovation and greater deployment of high-capacity satellite services.

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SES S.A. ("SES") and its subsidiary O3b Limited ("O3b" together "the Companies") submit these comments regarding the Federal Communications Commission's ("Commission's") proposals in the Notice of Proposed Rulemaking ("NPRM")[1] in the above-captioned proceeding to add fixed-satellite service ("FSS") allocations to the Ka-band and to update certain rules governing the operation of FSS space stations to enable greater licensing flexibility, as described below.

O3b and SES commend the Commission for initiating this rulemaking, which will facilitate the deployment of improved satellite services by allocating additional spectrum for use by both non-geostationary-satellite orbit ("NGSO") and geostationary-satellite orbit ("GSO") FSS systems. FSS networks are critical to ensuring that U.S. businesses and consumers have adequate access to broadband service and will be an essential component of future networks, including Fifth Generation ("5G") mobile networks. By formally authorizing GSO FSS and NGSO FSS systems to use spectrum that the Commission's International Bureau has previously

[1] *In the Matter of Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Notice of Proposed Rulemaking, 31 FCC Rcd 13651 (Dec. 15, 2016) ("NPRM").

allowed only via waiver,[2] the Commission's NPRM proposals provide O3b, SES, and other satellite industry participants with the certainty needed to continue their record of investing in multibillion dollar networks that will support a variety of new and advanced services to customers.[3] Many of the Commission's proposals will promote more flexible use of spectrum resources and foster continued innovation and broader access to satellite services, including the high-capacity, low-latency services provided by NGSO FSS operators like O3b.

For these and other reasons discussed in more detail below, O3b and SES support many of the Commission's proposals to add FSS spectrum allocations in the 17.8-20.2 GHz and 29.3-29.5 GHz bands,[4] subject to the technical limitations and other requirements described in these Comments. The Companies also propose further expansion of FSS use of 19.3-19.7 GHz and 29.1-29.5 GHz given the very limited usage to date. For example, FSS should be granted access to the 19.4-19.6 GHz and 29.1-29.3 GHz bands to the extent they are unused by NGSO MSS systems. To ensure ongoing NGSO FSS operations are not disrupted, O3b and SES further

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[2] *See* NPRM ¶ 6; *Northrop Grumman Space & Mission Systems Corporation, Applications for Authority to Operate a Global Satellite System Employing Geostationary Satellite Orbit and Non-Geostationary Satellite Orbit Satellites in the Fixed-Satellite Service in the Ka-band and V-band*, Order and Authorization, 24 FCC Rcd 2330, 2355 ¶ 75 (IB 2009) ("*Northrop Grumman License*"); *contactMEO Communications, LLC, For Authority to Launch and Operate a Non-Geostationary Orbit Fixed-Satellite System in the Ka-band Frequencies*, Order and Authorization, 21 FCC Rcd 4035, 4045 ¶ 26 (IB 2006); O3b Limited, Stamp Grant, IBFS File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (granted Jan. 22, 2015); *Inmarsat Mobile Networks, Inc., Application to Operate a Fixed-Satellite Service Gateway Earth Station Facility in Lino Lakes, Minnesota with the Inmarsat-5 F2 Space Station*, Order and Authorization and Declaratory Ruling, 30 FCC Rcd 2770, 2778-79 ¶ 25 (IB/OET 2015) ("*Inmarsat Grant*"); *ViaSat, Inc.*, Stamp Grant, IBFS File No. SAT-LOI-20080107-00006 (granted Aug. 18, 2009).

[3] *See* SES Americom, Inc., Spectrum Frontiers Reply Comments, GN Docket No. 14-177, *et al.* at 3-4 (filed Oct. 31, 2016).

[4] *See* NPRM ¶ 8.

propose that later NGSO FSS entrants to the Ka-band be required to protect all previously licensed FSS systems in the event of an in-line event. We also support the elimination of the global coverage requirements currently contained in Sections 25.145(c)(1) and 25.146(i)(2) of the Commission's rules. In addition, O3b and SES propose that the Commission consider modifying its milestone proposal to better reflect economic realities and foster greater investment, satellite deployment and competition.

I. O3b AND SES ARE INVESTING IN ADVANCED SATELLITE TECHNOLOGIES TO MEET CRITICAL CUSTOMER REQUIREMENTS.

The satellite sector is experiencing a renaissance in technological and service innovation and investment that will ensure that satellites continue to play a major role in expanding access to high-capacity connectivity throughout the United States and around the globe.[5] This renaissance includes the development of more advanced, spectrally-efficient satellite system designs and applications for high-capacity services.[6] Although O3b's NGSO FSS service began as an innovative means to reach populations unserved by terrestrial services, it has evolved to provide greater availability of broadband services even in well-established markets, giving customers of all types (individuals, enterprises, carriers, and governments) more choice, improved service, and better value.[7] SES is making similar technological advances in the GSO FSS systems realm with the upcoming launch of two high-throughput satellites, which will greatly increase the broadband speeds available to U.S. enterprise customers and improve overall

[5] *See* O3b Limited, Comments, GN Docket No. 14-177, *et al.* at 7-8 (filed Jan. 15, 2015) ("*O3b Spectrum Frontiers NOI Comments*").

[6] *See* O3b Limited, Reply Comments, GN Docket No. 14-177, *et al*. at 5-6 (filed Feb. 17, 2015) ("*O3b Spectrum Frontiers NOI Reply Comments*").

[7] *See O3b NOI Comments* at 5, 8.

spectrum efficiency.

The benefits of the recent groundbreaking advances by satellite operators are clear.[8] Satellite companies operating in the Ka-band frequencies are already deploying powerful spot beams to provide enterprise-level reliability, fiber-like latency, and very high-capacity.[9] O3b, for example, uses steerable spot beams that dynamically focus capacity wherever it is needed, including to oil and gas platforms in the Gulf of Mexico, to fixed and mobile network operators on islands such as American Samoa, to governments providing high-performance connectivity to remote areas, and to international organizations that require access to cloud computing from the field. SES and O3b are also working with manufacturers to develop state-of-the-art flat panel and phased array antennas that reduce costs and improve quality of service.[10] Commission initiatives to increase access to spectrum resources will help to sustain this growth and bring additional services to customers in unserved and underserved areas.

A. *About O3b*

O3b's authority to serve the U.S. market and its significant infrastructure in the United States are foundational elements of the commercial success that O3b's Ka-band NGSO FSS satellite system now enjoys. To date, the Commission's International Bureau has granted U.S. market access to twelve O3b Medium Earth orbit ("MEO") satellites, and has authorized

[8] O3b Limited, Reply Comments, GN Docket No. 14-177, *et al.* at 6 (filed Feb. 26, 2016) (*"O3b Spectrum Frontiers NPRM Reply Comments*").

[9] *Id.*

[10] *Id.*

numerous O3b earth stations in the U.S., including two gateways[11] and the O3b global Network Operations Center in Manassas, Virginia.[12] Each facility represents a multi-million dollar investment in support of O3b's robust global service offerings.[13] The O3b satellite system currently uses the 27.6-28.4 GHz and 28.6-29.1 GHz bands for uplinks and the 17.8-18.6 GHz and 18.8-19.3 GHz bands for downlinks; some of these bands are used pursuant to waivers granted by the International Bureau.[14] In the last year, O3b has submitted filings requesting U.S. market access for additional NGSO satellites and frequencies to accommodate the growing

[11] In September 2012, the Commission granted O3b a license to operate a gateway earth station in Haleiwa, Hawaii, to communicate with its NGSO FSS system. *See* FCC File No. SES-LIC-20100723-00952 (granted September 25, 2012) (the "Hawaii License"). In June 2013, the Commission granted O3b a license to operate a second gateway in the United States, located in Vernon, Texas (the "Texas License"). *See* FCC File No. SES-LIC-20130124-00089 (granted June 20, 2013). In January 2015, the Commission granted O3b approval to add four further NGSO satellites to O3b's previous U.S. market access grants, for a total of twelve satellites currently in equatorial orbit. *See* O3b Limited, IBFS File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (granted Jan. 22, 2015) ("Market Access Grant").

[12] O3b's U.S. gateway earth stations are located in Vernon, Texas and Sunset Beach, Hawaii. Key earth stations are also located at its global Network Operations Center near Manassas, Virginia. *See, e.g.,* the Hawaii License; the Texas License; and Application of O3b Limited, IBFS File No. SES-LIC-20160712-00640 (granted Nov. 7, 2016) (the "Virginia License").

[13] *See O3b Spectrum Frontiers NOI Reply Comments* at 2 ("The O3b satellites, and the O3b ground network that support the satellites and O3b's customers, represent substantially more than $1.2 billion dollars in investment in advanced research and development, manufacturing (including spacecraft, gateway earth stations, next-generation modem development), IP networking, installation, and ongoing operation.").

[14] O3b's U.S. operations are currently subject to waivers of the Ka-band Plan and the U.S. Table of Frequency Allocations and additional conditions. *See* Market Access Grant, Conditions 4-14. O3b's satellites operate under the authority of the United Kingdom. O3b's system was designed and built to use Ka-band frequencies, including the 27.6-28.4 GHz band. This portion of the Ka-band is allocated to FSS (Earth-to-space) on a co-primary basis internationally, and is essential to operation of O3b's network throughout the world. O3b has to date been able to work within the constraints of the U.S. treatment of FSS as secondary to FS in this band. *See O3b NPRM Comments* at ii, 3-4, 13.

demand for its high-performance and innovative service.[15]

O3b's system offers low-latency, high-throughput satellite connectivity—generally ten to one hundred times the throughput of a traditional satellite—to Internet service providers, fixed and mobile network operators, large enterprises, mobility customers and governments, to enable fast, flexible and affordable broadband connectivity in locations unserved or underserved by terrestrial networks.[16] O3b's satellite constellation reaches customers in over 180 countries across Latin America, Africa, the Middle East, Asia and Australia,[17] enabling broadband connectivity for a collective population of over 3 billion people.[18]

For example, O3b is the leading satellite provider of capacity in the Pacific, with a total contracted capacity of more than 7.5 Gbps by the end of 2016.[19] O3b provides 1.2 Gbps of capacity to the American Samoa Telecommunications Authority ("ASTCA") alone, which has

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[15] *See* Modification Application of O3b Limited, IBFS File No. SAT-MOD-20160624-00060 (filed June 24, 2016) ("Modification Application"); Amendment Application of O3b Limited, IBFS File No. SAT-AMD-20161115-00116 (filed Nov. 15, 2016) ("November Amendment"). In those applications, O3b requested authority to serve the U.S. using additional frequencies (19.7-20.2 GHz and 29.5-30.0 GHz) on four of the eight satellites proposed in the Modification Application and requested U.S. market access for up to twenty-four new satellites that will operate in a circular equatorial orbit and for up to sixteen new satellites that will operate in an inclined orbit using the frequencies covered by the Market Access Grant as well as the 17.7-17.8 GHz, 19.3-19.7 GHz, and 29.1-29.5 GHz frequency bands. Those applications are currently pending before the Commission.

[16] *See O3b Spectrum Frontiers NPRM Comments*, at 2.

[17] *See* O3b Networks, Corporate Brochure, at 9 (Sept. 2014), http://bit.ly/2lfV381.

[18] *See O3b Networks Delivers Global Broadband Connectivity*, O3b Networks, http://bit.ly/2lfO3rH (last visited Feb. 16, 2017).

[19] This level represents an increase of approximately 30% year-on-year growth for the total used bandwidth in the Pacific region. *See* Press Release, O3b Networks Continues Major Growth Across the Asia Pacific Region, Enabling Operators to Provide 3G and 4G Mobile Data Services, O3b Networks (Jan. 16, 2017), http://bit.ly/2lfN4Yw.

more than doubled that territory's backhaul and Internet capacity, and supports the Broadband Linking the American Samoa Territory ("BLAST") Project to connect all of American Samoa's main islands.[20]

O3b's system enables access to the information resources available in the world's major urban centers from remote locations, including a university in Papua New Guinea,[21] the Galapagos Islands,[22] cities in the Amazon,[23] the Solomon Islands,[24] oil and gas platforms,[25] and vessels around the globe,[26] highlighting the unique capabilities of NGSO FSS networks to create new platforms for broadband services where little or no terrestrial infrastructure exists. O3b's

[20] Caleb Henry, *O3b Sees Contract Surge, Targets New Markets*, Satellite Today (June 19, 2015), http://bit.ly/2loy6y1. O3b also entered a multi-year strategic framework agreement with Bharti Airtel for IP trunking services to Timor-Leste to support 2G and 3G services, and its existing customers, Our Telekom of the Solomon Islands, Royal Caribbean, Digicel PNG in Papua New Guinea, and Palau National Communications Corporation ("PNCC") have all upgraded their contracts with O3b to bolster telecommunications services to their respective service areas. *See id.*

[21] *See* Press Release, O3b Satellite Network Brings Digital Parity to First University Customer, O3b Networks (Mar. 17, 2015), http://bit.ly/2my8nDs.

[22] *See* Press Release, Ecuador's Largest Broadband Provider CNT EP to use O3b Networks to bring High Speed Broadband Service to Galápagos Islands, O3b Networks (Nov. 17, 2015), http://bit.ly/2lsNfgV.

[23] *See* Press Release, Skynet Goes Live on O3b Networks Delivering High Speed Broadband Services to Rural Colombia, O3b Networks (Sep. 2, 2015), http://bit.ly/2m06z8v.

[24] *See* Press Release, Our Telekom Increases O3b Antenna Size, Boosting Maximum Fiber-equivalent Throughout Capabilities, O3b Networks (Jan. 16, 2017), http://bit.ly/2mnJduj.

[25] *See* Press Release, RigNet and MODEC Sign Agreement to Deliver Fiber-equivalent O3b Satellite Connectivity to Offshore Brazilian FPSO Fleet, O3b Networks (Oct. 24, 2016), http://bit.ly/2m09rSU.

[26] *See* Press Release, Ob3 Connect Royal Caribbean "Smart Ship" Anthem of the Seas in the Mediterranean, O3b Networks (Jun. 17, 2015), http://bit.ly/2mnWfYX.

U.S. customers—and the customers they serve—are taking advantage of these capabilities.[27] Because of O3b's orbit, the company is also well suited to provide low-latency connectivity for rural telecom operators and mobile backhaul.[28] In both urban and remote environments, O3b is also helping local telecommunications operators and ISPs introduce fiber-like connectivity where none existed before.[29]

And O3b is still growing.[30] After less than three years in service, O3b already needs substantially more capacity to meet the emerging demand for its high-throughput, high-performance connectivity.[31]

B. *About SES*

SES is one of the world's largest commercial communications satellite operators. SES

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[27] *O3b Spectrum Frontiers NOI Comments* at 3-4, 5-6; *O3b Spectrum Frontiers NOI Reply Comments* at 2-3; *O3b NPRM Comments* at 2-7.

[28] *O3b Spectrum Frontiers NOI Comments* at 5-6.

[29] For example, O3b now delivers broadband Internet and 4G/LTE service in 15 countries across Africa, with African customers contracting over 7 Gbps of Internet capacity. Carole Kamaitha, *Enabling Growth and Opportunity through High-Speed Internet in 15 African Countries*, O3b Networks Blog (Nov. 14, 2016), http://bit.ly/2fsrxuA.

[30] Mark Holmes, *O3b CEO Talks Capital Expenditure Plans – "Massive Step Up" on the Horizon*, Via Satellite (Feb. 14, 2017), http://bit.ly/2kPKlBT (Steve Collar, O3b's CEO, said "The concept of O3b was always a scalable system and a scalable network that you can start small and grow as the market develops. We now have a well-proven value proposition to the market and the next set of satellites build on that strong base. I am very optimistic that the solution that we have for our follow-on architecture will be extremely competitive with anything else that is either in the market now or planned for the future.").

[31] O3b began full commercial operations in September 2014 and has since become the fastest growing satellite operator in history. Today, O3b supports connectivity for more than 40 customers worldwide, with more than 50% of those customers having already upgraded their service commitments to O3b during the first year of commercial operation. *See* Press Release, O3b Networks Announces the closing of $460M in Financing to Expand its Constellation and Support Unprecedented Customer Growth, O3b Networks (Dec. 10, 2015), http://bit.ly/2kStNcs.

subsidiaries operate more than 50 GSO satellites that are able to reach 99% of the world's population. Three of these entities—SES Americom, Inc., SES Satellites (Gibraltar) Ltd., and New Skies Satellites B.V.—hold many Commission authorizations for GSO space stations, both under U.S. license and through market access, and earth stations. SES GSO satellite capacity is used for such services as video and audio content distribution, direct-to-home services, private networks, broadband services, satellite news gathering, broadcasting, aeronautical and maritime services, and mobile backhaul.

SES has maintained an economic interest in O3b since 2009, and in 2016 acquired full ownership of the company. Therefore, the combined company offers a unique perspective on not only the impact the Commission's rules will have on both NGSO and GSO operations, but how NGSO and GSO systems must cooperate in their operations. The Commission's proposals to increase FSS access to a number of bands will improve the growth potential for all FSS operators. However, it is critical that the Commission establish an appropriate balance between NGSO and GSO operations and ensure that GSO satellites are not inadvertently or unnecessarily blocked from accessing spectrum available to all FSS service providers. The changes proposed in the NPRM will provide greater certainty regarding access to the spectrum required for NGSO and GSO operations, helping SES and O3b to continue to drive innovation and growth in the satellite sector for years to come.

II. O3b AND SES SUPPORT EXPANSION OF FSS IN THE KA-BAND.

The NPRM proposes rule changes to expand spectrum access for satellite operators and promote greater and more flexible use of spectrum resources. This will spur continued innovation and greater deployment of high-capacity satellite services. Accordingly, O3b and

SES agree with many of the Commission's allocation proposals, as discussed below.

A. *Revisions to the Ka-band Plan*

O3b and SES generally support the Commission's proposal to reinstate certain FSS use of the 17.8-20.2 GHz band and to allow new FSS operations in the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands. A chart is provided in Attachment A, adapted from Appendices A and C of the NPRM, which summarizes the Commission's proposals and reflects changes proposed by O3b and SES.

17.8-18.3 GHz. O3b and SES support the Commission's proposal to explicitly authorize FSS downlinks in the 17.8-18.3 GHz band, subject to power flux density ("PFD") limits to protect terrestrial fixed service ("FS") operations.[32] However, the Companies do not support the Commission's proposals to limit access on a secondary basis in the band or to limit FSS secondary use to individually-licensed earth stations. Instead, the Companies urge the Commission to make individually-licensed FSS earth stations eligible for co-primary status and to authorize blanket-licensed FSS terminals on a secondary basis with respect to terrestrial operations in the band.[33] This framework will better align the Commission's rules with policies in place abroad, promoting spectrum harmonization.[34]

[32] *See* NPRM ¶ 9.

[33] The Companies propose amendments to NGXX2 that reflect this recommendation *Compare* NPRM, Appendix A, *with* Attachment A.

[34] For example, the Electronic Communications Committee of the European Conference of Postal and Telecommunications Administrations ("CEPT"), recognizing that FSS and FS have primary status internationally, has adopted a policy that permits the deployment of both coordinated stand-alone FSS antennas and uncoordinated FSS user terminals in the 17.7-19.7 GHz spectrum, along with continued use of the spectrum for growing FS networks. *See* CEPT Electronic Communications Committee, ERC Decision (00)07, at 4-5 (approved Oct. 19, 2000 and amended March 4, 2016), http://bit.ly/2lOgopw.

According co-primary status to individually-licensed earth stations in the 17.8-18.3 GHz band will allow satellite operators to protect their significant investments in critical ground facilities without materially constraining the growth of terrestrial FS networks. As the NPRM observes, both GSO and NGSO FSS systems have been granted waivers permitting them to use the 17.8-18.3 GHz frequencies for earth stations sited at locations where they can operate successfully without interference from the installed base of terrestrial links using this band.[35] However, these FSS licensees would have no recourse if a terrestrial operator decided to deploy a new fixed link that would cause harmful interference and prevent reception of the satellite signal. An upgrade to co-primary status would eliminate this risk to the sunk investment in existing FSS ground station facilities. Going forward, both FS and FSS operators would have the opportunity to establish new installations subject to prior coordination under the procedures that apply in other spectrum shared on a co-primary basis between FSS and FS networks.

Allowing blanket licenses for satellite terminals to be issued in the 17.8-18.3 GHz band on a secondary basis with respect to terrestrial stations is also fully consistent with the Commission's objectives. Because these ground terminals would not transmit in this frequency segment, they cannot cause interference to terrestrial operations. Moreover, blanket-licensed stations would not be entitled to protection from interference caused by existing or future FS network transmissions and thus would not constrain FS expansion. Even on a secondary basis, however, a satellite network may find this spectrum attractive for blanket-licensed terminals, particularly if the terminals are frequency agile and can switch to a different band if they

[35] *See Inmarsat Grant* at 2778-79; O3b Limited, Stamp Grant, IBFS File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004, Condition 4 (granted Jan. 22, 2015) (approving NGSO FSS operations in the 17.8-18.6 GHz band).

experience interference from FS operations.

The band could also be used for aeronautical services, which are not susceptible to interference from terrestrial operations. In comparable circumstances, the Commission allowed earth stations aboard aircraft ("ESAAs") to use extended Ku-band spectrum on an unprotected basis, notwithstanding rules intended to preserve access to the spectrum for terrestrial fixed services.[36] Given that "ESAA downlink operations in these bands will not interfere with or restrict current or future FS operations" and "will not receive protection from the FS in these bands,"[37] the Commission determined that ESAA use of the extended Ku-band was fully consistent with the Commission's objective of protecting spectrum availability for FS systems. The same rationale applies here to permitting blanket-licensed aeronautical terminals in the 17.8-18.3 GHz frequencies on a secondary basis.

The Companies agree that PFD limits established by the International Telecommunication Union ("ITU") and already adopted domestically for the adjacent frequency bands[38] will ensure that terrestrial networks are not subject to harmful interference due to space station transmissions.[39] As discussed in the NPRM, U.S. terrestrial operators actively participated in the development of these limits. O3b and other satellite networks currently use

[36] *Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14-14.5 GHz Frequency Bands*, Notice of Proposed Rulemaking and Report and Order, 27 FCC Rcd 16510, 16520 ¶¶ 20-21 (2012).

[37] *Id.* ¶ 21.

[38] *See* 47 C.F.R. § 25.208(c) (identifying the same PFD limits for the 17.7-17.8 GHz and 18.3-18.8 GHz bands).

[39] NPRM ¶ 9 & n.26 (citing PFD limits set forth in Article 21, Table 21-4 of the ITU Radio Regulations).

these bands, and no harmful interference to FS networks has been reported. Given this evidence, the Commission should adopt its proposal to apply these ITU limits to FSS use of the 17.8-18.3 GHz band.

18.3-18.6 GHz and 19.7-20.2 GHz. O3b and SES support the Commission's proposal to allow NGSO FSS systems to operate so that they shall not cause unacceptable interference to, or claim protection from, GSO FSS networks in the 18.3-18.6 GHz and 19.7-20.2 GHz bands, subject to limits on equivalent power flux-density ("EPFD") to ensure protection of primary GSO FSS networks.[40]

18.8-19.3 GHz and 28.6-29.1 GHz. O3b and SES support the Commission's proposal to allow GSO FSS operations in the 18.8-19.3 GHz band so that they shall not cause unacceptable interference to, or claim protection from NGSO FSS systems, consistent with International Bureau waivers and the current secondary GSO FSS designation in the paired 28.6-29.1 GHz band.[41] O3b and SES do not support a co-primary GSO FSS allocation with NGSO FSS operations in the 18.8-19.3 GHz band or in the 28.6-29.1 GHz band.[42] These are the only bands in which NGSO FSS operations are primary, and in their business planning, NGSO FSS operators have relied on having a higher status than GSO FSS operators in this portion of the band.[43]

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[40] *See* NPRM ¶ 10; *id.*, Appendix C; *id.*, Appendix A (proposed footnote NGXX3); discussion on EPFD limits, *infra* Section IV.B.

[41] *See* NPRM ¶ 11; *id.*, Appendix C; *id.*, Appendix A (proposed footnote NG165); *and* discussion on EPFD limits, *infra* Section IV.B.

[42] *See* NPRM ¶ 12.

[43] O3b and SES also support the new footnote NG165, which mandates that GSO FSS operations shall not cause harmful interference to, or claim protection from, non-geostationary-satellite

19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz. O3b and SES agree with the Commission's proposal to permit FSS systems to operate in these bands on a co-primary basis with FS in the 19.3-19.4 GHz and 19.6-19.7 GHz bands.[44] Among FSS operations, NGSO FSS shall not cause unacceptable interference to, or claim protection from, GSO FSS networks in the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands. Such a change will put underutilized spectrum to more extensive use.[45]

O3b and SES further concur that, in the 19.3-19.4 GHz and 19.6-19.7 GHz bands, which are shared on a co-primary basis with terrestrial services, FSS earth stations (GSO and NGSO) may be individually licensed on a co-primary, first-come first-served basis, and coordinated with terrestrial stations; however there should be no restrictions on FSS operators' ability to deploy other types of earth stations on a secondary basis.[46] While a co-primary allocation requires coordination, blanket operations on a secondary basis would not result in any increased interference to terrestrial operators. Further, similar to the 17.8-18.3 GHz band, this band is used for satellite downlinks, and the receiving satellite earth stations will not cause interference to terrestrial operations regardless of their number or location. Therefore, FSS operators should not be unnecessarily limited in their ability to use the spectrum if they are able to design earth stations capable of operating on a secondary basis.

19.4-19.6 GHz and 29.1-29.3 GHz. Although not proposed by the Commission, O3b and

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systems in the fixed-satellite service in the 18.8-19.3 GHz and 28.6-29.1 GHz bands. *See* NPRM, Appendix A.

[44] *See* NPRM ¶ 13; *id.*, Appendix C; *id.*, Appendix A (proposed footnote NGXX3).

[45] *See* NPRM ¶ 13.

[46] *See id*.

SES recommend that the Commission also allow FSS operations (NGSO and GSO) greater access to the 19.4-19.6 GHz and 29.1-29.25 GHz bands for NGSO and GSO FSS systems, and to 29.25-29.3 GHz for NGSO FSS systems,[47] which are not fully utilized across the United States.[48] One example of increased access would be to allow FSS access to the opposite, available polarization. Under such an approach, NGSO FSS operations (not providing feeder links to the mobile-satellite service) would be authorized so that they shall not cause unacceptable interference to, or claim protection from, GSO FSS operations. Attachment A provides suggested revisions to the Ka-band Plan to account for this proposal.

B. *Effect of Rule Changes on Current Licensees*

To avoid any ambiguity, the Commission should also expressly confirm that any expanded spectrum access and interference protection rights adopted in this proceeding will be granted to existing licensees authorized by waiver to operate in such bands, consistent with previous practice.[49]

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[47] GSO FSS systems are already authorized for blanket licensing in the 29.25-29.5 GHz band pursuant to the Commission's band plan and Section 25.138 of the Commission's rules. 47 C.F.R. § 25.138.

[48] *See* Iridium Constellation LLC, IBFS File No. SAT-MOD-20131227-00148, Application for Modification of NGSO Authorization to Launch and Operate Replacement Satellites, at 12-13 (granted Aug. 1, 2016) (noting that both the Iridium Block 1 satellites and the Ka-band feeder link beams for the Iridium NEXT system "operate with a single circular polarization in each direction").

[49] *See, e.g.*, *Flexibility for Delivery of Commc'ns by Mobile Satellite Serv. Providers*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 1965 ¶ 3 (2003) ("*MSS Flexibility R&O*") (modifying existing MSS licensees' grants to include the provision of additional services authorized in that same order, provided existing licensees demonstrate satisfaction of established "gating criteria"); *Flexibility for Delivery of Commc's by Mobile Satellite Service Providers in the 2GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Memorandum Opinion and Order and Second Order on Reconsideration, 20 FCC Rcd 4616, 4620-21 ¶¶ 10-12 (2005) (confirming and clarifying *MSS Flexibility R&O*). Although the Commission has in the past required existing

C. *Codification*

As noted in the NPRM, many aspects of the Commission's proposals have already been permitted via waiver and been shown to be effective.[50] Codifying these existing practices in the Commission's rules will create a more predictable licensing and operating environment. Accordingly, O3b and SES agree with the Commission's proposal to "codify the Ka-band Plan's satellite designations into footnotes to the U.S. Table of Frequency Allocations."[51] The Companies do not, however, support the Commission's apparent intention to remove from Section 25.202(a)(1) the list of frequency bands available for FSS,[52] as they find the list to be a useful reference. The Companies support modifying the language in note 6 of Section 25.202(a)(1) of the Commission's rules to replace the term "gateway earth stations" with "individually-licensed earth stations" for the reasons expressed in the NPRM.[53]

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licensees to file a modification application to take advantage of newly adopted rules, the Commission should not do so here. *See Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Space Stations Aboard Aircraft*, Notice of Proposed Rulemaking and Report and Order, 27 FCC Rcd 16510, 16553-54 ¶¶ 115-16 (2012) (requiring that licensees operating pursuant to a waiver must file a modification in order to be granted the benefits of new rules adopted by the Commission). Imposing such a requirement on NGSO FSS systems operating pursuant to waivers would only drain resources from licensees and conflict with the Commission's stated goals to promote greater flexibility and remove unnecessary restrictions on FSS systems. *See* Appendix D.

[50] *Inmarsat Grant at* 2778-79 (2015); O3b Limited, Stamp Grant, IBFS File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (granted Jan. 22, 2015); ViaSat, Inc., Stamp Grant, IBFS File No. SAT-LOI-20080107-00006, Condition 4 (granted Aug. 18, 2009).

[51] *See* NPRM ¶ 14.

[52] *Id.*; *id.*, Appendix A § 25.202(a)(1).

[53] *Id.* ¶ 14 & n.42.

III. THE COMMISSION MUST REVISE ITS DEFAULT SHARING RULES IN SECTION 25.156(d)(5).

O3b and SES support the Commission's proposed deletion of the first sentence of Section 25.156(d)(5), which addresses a situation in which the Commission receives an application for either NGSO-like operations or GSO-like operation in a frequency band in which it has not adopted frequency-band-specific service rules. In such circumstances, the rule language precludes the Commission from considering the NGSO-like application if a GSO-like application has already been granted, and vice-versa.[54] In support of its proposed elimination of this provision, the NPRM explains that "an applicant demonstrating that it can operate compatibly with any existing operations, either through technical demonstrations or coordination, ought not to be precluded from providing service to the public while the Commission initiates and conducts a rulemaking to establish formal sharing criteria."[55]

The Companies urge the Commission to delete the second sentence of Section 25.156(d)(5) as well[56] as both sentences of the current rule reflect a default sharing approach based on time of filing that is no longer warranted.

IV. TECHNICAL ISSUES

As discussed in more detail below, O3b and SES support many of the proposals made by the Commission. O3b and SES, however, object to certain of the Commission's technical proposals and recommend modifications to several others.

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[54] *Id.* ¶ 21; *see also* 47 C.F.R. § 25.156(d)(5).

[55] NPRM ¶ 21.

[56] Only the first sentence of the rule is mentioned in the NPRM. *See id.* ¶ 21; *id.,* Appendix A (proposing revisions to Section 25.156(d)(5)).

A. *PFD Limits*

O3b and SES agree with the Commission's proposal to include in its rules the ITU-adopted PFD limits on space stations in the 17.8-18.3 GHz band to protect primary FS operations.[57] These PFD limits were developed through a rigorous stakeholder-supported process that included input from U.S. terrestrial operators.[58] O3b and SES agree that these limits can be relied upon to protect terrestrial fixed services without generally requiring coordination.[59]

The Companies also support the Commission's proposal to make the limits in Section 25.208(c) of the Commission's rules applicable to GSO FSS space stations in the 17.7-19.7 GHz band and to all space stations in the 22.55-23.55 GHz and 24.45-24.75 GHz bands.[60] O3b and SES similarly support the Commission's proposal to apply the limits in Section 25.208(e) to NGSO FSS space stations in the 17.8-18.6 GHz and 18.8-19.7 GHz bands.[61]

Although O3b and SES are sensitive to the Commission's concerns regarding these PFD limits in the context of some NGSO FSS constellations, O3b and SES do not support the establishment of an EPFD limit for NGSO FSS systems in the 17.8-18.6 GHz and 18.8-19.7 GHz bands to protect terrestrial stations. Instead, O3b and SES propose that the Commission take into account the fact that satellites beyond the horizon of any one point on the Earth do not contribute

[57] *See* NPRM ¶ 9.

[58] *See id.* ¶ 9; *see also* Final Acts WRC-03, World Radiocommunication Conference (Geneva, 2003) (requiring the Bureau to verify that NGSO FSS systems comply with EPFD limits of Article 22 of the Radio Regulations); Radio Regulations, Articles, Article 22 (2012 ed.), http://bit.ly/2lFdHHI.

[59] *See id.* ¶ 9.

[60] *Id.* ¶ 15.

[61] *Id.* ¶ 16.

to the PFD at that point and should therefore be excluded from the PFD calculation.[62] This approach is more straightforward than developing an EPFD limit that would largely depend on the FS station's link performance and antenna pointing to be accurate and meaningful.

O3b and SES also do not support the Commission's alternate proposal that the PFD of the entire NGSO FSS constellation not exceed −115 (dBW/m^2)/MHz on any point on the Earth's surface to protect terrestrial stations until an EPFD limit is developed.[63] This limit would be too constraining for operations at high elevation angles where the gain of the victim terrestrial stations rolls off substantially in the direction of the NGSO satellite. We therefore oppose adoption of the new language for Section 25.208(e) proposed in the NPRM.

B. *EPFD Limits*

O3b and SES support the Commission's proposal to allow NGSO FSS systems to operate so that they shall not cause unacceptable interference to, or claim protection from GSO FSS operations in the 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz, and 29.5-30 GHz bands, subject to the Article 22 equivalent power flux-density ("EPFD") limits.[64] The Companies also support the Commission's proposal to extend the relevant EPFD limits to the 19.3-19.4 GHz, 19.6-19.7 GHz, and 29.3-29.5 GHz bands in which the Commission proposes to allow new

[62] *See* Space Exploration Holdings, LLC, Application for Authority for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, Application, IBFS File No. SAT-LOA-20161115-00118, Technical Attachment at 31 (filed Nov. 15, 2016) (providing a PFD analysis which corrects one variable in the calculation, such that only satellites with a direct line of sight to a given location on the ground are considered).

[63] *See* NPRM ¶ 16.

[64] *See id*. ¶¶ 9-10, 19, 21.

NGSO FSS operations.[65] However, O3b and SES believe there is an error in both the title and the text of Section 25.146 set forth in Appendix A, as both incorrectly refer to the 18.8-19.3 GHz and 28.6-29.1 GHz bands.[66] The ITU's EPFD limits are not applicable to these frequency bands.

O3b and SES agree that compliance with EPFD limits established by the ITU will be sufficient to protect GSO FSS networks from unacceptable interference, and promote harmonization in the international operation of NGSO FSS systems.[67] Specifically, O3b and SES support the following requirements:

- *Single-entry validation EPFD*: O3b and SES support the adoption of the ITU specifications for single-entry validation of compliance with the $EPFD_{down}$, $EPFD_{up}$ and $EPFD_{is}$ limits in the applicable bands and support requiring an NGSO FSS system applicant to include a comprehensive technical showing on these matters as part of its application.
- *Operational EPFD*: O3b and SES recommend that the Commission require applicants to demonstrate their NGSO FSS system's ability to meet the operational $EPFD_{down}$ limits at the time it files its application, rather than deferring the showing to a date ninety days prior to its planned service commencement. To reflect this change, O3b and SES propose moving the relevant text regarding operational limits from current Section 25.146(b)(2)

[65] *See id.* ¶ 19.

[66] *See id.*, Appendix A.

[67] *See id.* ¶ 10 n.35; *see generally Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, First Report and Order and Further Notice of Proposed Rulemaking, 16 FCC Rcd 4096 (2000) ("*Ku-band NGSO FSS Allocation Order*") (explaining NGSO FSS operations can share successfully with GSO FSS networks without causing unacceptable interference by complying with ITU-adopted EPFD limits).

into Section 25.146(a).

- *Aggregate EPFD*: O3b and SES support the adoption of the ITU's aggregate EPFD limits into the Commission's rules. As the Commission has recognized previously,[68] it is the combination of validation EPFD limits, operational EPFD limits and aggregate EPFD limits that provide protection to GSO FSS systems. As a result, it is important for the Commission to develop a mechanism to ensure that the aggregate EPFD limits into GSO FSS systems are not exceeded.

In the bands 17.8-18.6 GHz, 19.3-19.4 GHz, 19.6-20.2 GHz, 27.5-28.6 GHz, and 29.3-30 GHz, O3b and SES do not support:

- *Ninety days prior to service*: As noted above, the Companies recommend that a comprehensive showing of the operational limits be included in the initial application rather than ninety days prior to service.
- *Test points*: The NPRM's proposed language for Sections 25.146(a) and (b) state that test points will be provided by the Commission based on information supplied by U.S.-licensed GSO FSS and BSS operators. The Companies note that the process for determining the test points to be used to demonstrate EPFD compliance is not clear and recommends consideration of alternative methods for demonstrating compliance. For example, the international rules to determine the compliance with EPFD limits are based

[68] *Ku-band NGSO FSS Allocation Order*, 16 FCC Rcd at 4129-30 ¶ 77 ("[W]e believe that NGSO FSS adherence to the three elements of the single entry limits (*i.e.*, validation limits, operational limits, and additional operational limits), as well as aggregate limits . . . will adequately protect GSO FSS networks"); *see also id*. at 4140 ¶ 106 ("We find that the cumulative level of interference from all co-frequency NGSO FSS systems, *i.e.*, the aggregate level, is what must be limited.").

upon the determination of the worst case geometry between the NGSO FSS system and the GSO FSS system (earth station and space stations).

- *Computer program and source code*: The ITU recently released its EPFD validation software, which NGSO FSS applicants are expected to use to evaluate and demonstrate conformance with the Article 22 EPFD limits. However, O3b and SES believe that the proposed ITU software does not adequately model the O3b system. The Companies are actively engaged in the development of possible revisions to Recommendation ITU-R S.1503 currently ongoing at the ITU[69] to improve the Recommendation and the underlying software, and request that the Commission continue to work within the ITU to ensure its software can accurately assess a variety of NGSO FSS system designs. In the meantime, the Companies request that the Commission consider alternative means for NGSO FSS operators to demonstrate compliance with EPFD limits that can be validated by potentially affected parties.
- *Satellite resource power and traffic/beam switching strategy*: Section 25.146(a)(1) states that "the PFD masks must encompass the power flux-density radiated by the space station regardless of the satellite transmitter power resource allocation and traffic/beam

[69] In June 2016, the ITU's Radio Communications Bureau ("BR") announced efforts to improve the software tool used to calculate EPFD levels produced by NGSO FSS systems through contracts with software companies from the United Kingdom and France. *See* ITU-BR, Circular Letter CR/405, Equivalent Power Flux-Density (EPFD) Validation Software (Resolution 85 (WRC-03)) (June 3, 2016), http://bit.ly/2mmspDV. The ITU released its new software in October 2016, but is continuing to work with stakeholders to improve the platforms. *See* BR, ITU, User Guide: Equivalent Power Flux-Density Limits Validation Software Test Version, Version 1.1 (Oct. 2016), http://bit.ly/2lO8Q68; BR IFC 2836 - News, http://bit.ly/2m5a3qA.

switching strategy that are used at different periods of a NGSO FSS system's life."[70] O3b and SES do not support this requirement as the revisions currently being considered by the ITU membership for Recommendation ITU-R S.1503 address beam pointing strategies and other power control techniques to improve the software's ability to model NGSO FSS systems being deployed today.[71]

- *Clarification of Tables 2G and 2H in 25.208*: O3b and SES would like to clarify that Tables 2G and 2H are not standalone provisions, but are linked to Tables 1G and 1H as noted by the footnotes to these two tables. For the avoidance of doubt, O3b and SES propose that Tables 2G and 2H be incorporated into the footnotes associated with Tables 1G and 1H.

C. *Avoidance of In-line Interference*

O3b and SES support the Commission's proposals to apply the default procedures for the avoidance of in-line interference among NGSO FSS systems to the additional bands in which NGSO FSS operations are proposed.[72]

1. In-line Events Between Existing Systems

The Companies support allowing NGSO FSS operators to reach a coordination agreement that accounts for in-line events instead of simply dividing the spectrum between two or more NGSO FSS systems. Sharing among NGSO FSS satellite systems is possible through

[70] *See* 47 C.F.R. § 25.146(a)(1)(i).

[71] *See supra* note 70 and accompanying text.

[72] *See* NPRM, Appendix A, § 25.261 (expanding the scope of the rule to also include the 17.8-18.6 GHz (space-to-Earth), 19.3-19.4 GHz (space-to-Earth), 19.6-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), and 29.3-30 GHz (Earth-to-space) bands).

coordination between the operators and is an efficient means of establishing a baseline for handling in-line events. Furthermore, it will help avoid the mishandling of spectrum resources by dividing bands into unusable segments.[73]

The O3b equatorial orbit is inherently well-isolated from in-line interference events with respect to other types of NGSO FSS system orbits, particularly those involving highly-inclined orbit geometries. In the rare case of co-frequency, co-coverage in-line interference events with either the equatorial O3b satellites or O3b's proposed constellation of inclined orbit satellites,[74] coordination may be achieved based on a time-varying unavailability similar to a sun outage event. As a last resort, operators can rely on a band segmentation scheme with respect to the other NGSO FSS systems, as contemplated by Section 25.261. O3b will rely on angular separation between orbital arcs, satellite diversity, and (as a last resort) band segmentation to address any potential in-line interference events with other NGSO satellite systems. Other

[73] In several situations, the Commission has divided spectrum bands among various operators, leaving each operator with less spectrum than necessary for its system. As a result, operators were forced to conduct inefficient secondary market transactions to re-consolidate spectrum, causing delays and wasting resources that have continued for years. *See, e.g., Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands, et al.*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962 (2003); *Request for Special Temporary Authority, Iridium Constellation, LLC, for a Mobile Satellite System in the 1.6 GHz Frequency Band*, Order, File No. SAT-STA-20040319-00056 (2004) (granting Iridium authority to use the same band as Globalstar); *see Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service*, Third Report and Order, 25 FCC Rcd 7610, 7610 ¶ 1 n.4 (2010) (referencing *Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rule Making, 20 FCC Rcd 2906 (2005)); Globalstar, Inc., Comments, File Nos. SAT-MOD-19961204-00139, SAT-AMD-20050816-00160, SAT-AMD-20051118-00236 (filed Jan. 11, 2012); Monica Alleven, *Globalstar Not Interested in Iridium's Latest Spectrum Sharing Proposal*, FierceWireless (Apr. 27, 2015), http://bit.ly/2kG2CWX.

[74] *See* November Amendment at 6, 20.

NGSO FSS operators are similarly supportive of allowing NGSO FSS operators to coordinate their operations before resorting to band segmentation.[75]

O3b and SES also recommend the following reforms to the Commission's in-line event rules to maximize the benefits of its proposals.[76] First, O3b and SES believe the definition of an in-line event could be narrowed to cover only angular separations of less than ten degrees. The Companies understand the rule to define an in-line event where two or more NGSO satellites are operating within a ten-degree cone of the respective collocated earth stations.[77] The current ten-degree separation threshold for co-frequency NGSO FSS space station operations is based on the characteristics of satellite and earth station systems proposed at the beginning of this century. Much innovation has occurred since that time. The Companies therefore recommend that the Commission consider a smaller angle than the current ten-degree threshold based on current earth station designs to reduce the number of cases that trigger the requirement for NGSO FSS operators to coordinate.

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[75] *See, e.g.*, The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service, Application, IBFS File No. SAT-LOA-20160622-00058, at 70 (filed June 22, 2016) (advocating that spectrum sharing among NGSO systems is possible, as the Commission recognized when adopting its in-line interference default procedures); Space Exploration Holdings, LLC, Application for Authority for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, Application, IBFS File No. SAT-LOA-20161115-00118, at 12 & n.9 (filed Nov. 15, 2016) (stating it will "seek in every case to reach coordination agreements that optimize spectrum efficiency and allow for the greatest operational flexibility possible among the systems, consistent with the Commission's rules and policies.").

[76] *See* NPRM ¶¶ 22-23, Appendix A, § 25.261.

[77] The earth station of the NGSO satellite systems must be within the same geographic area to be considered as triggering an in-line event. At certain distances, depending on the altitude of the NGSO satellites, there will no longer be an in-line event, as the beam roll-off of the satellite beams is sufficient to avoid harmful interference.

Second, O3b and SES support requiring NGSO FSS licensees in the bands currently allocated for, or proposed for, NGSO FSS operations to maintain a website with ephemeris data for each satellite in its constellation.[78] Specifically, O3b and SES do not oppose the Commission's proposals to compile ephemeris data for publication on websites of the Space Data Association and/or the United States Strategic Command's Joint Space Operations Center. The Companies are concerned, however, that this approach could become unworkable given the sheer number of satellites proposed for deployment. Unless this information is accurate, there could be little value in using it to determine when an in-line event could occur.

Third, O3b and SES request that the Commission clarify that Section 25.261 applies only to NGSO FSS systems communicating with earth stations with directional antennas operating in U.S. territory. All earth station antennas in the proposed new NGSO FSS bands are necessarily directional, including mobile antennas. However, O3b and SES understand that the proposed 25.261 rule for non-U.S.-licensed NGSO satellite systems would only apply to earth stations operating within U.S. territories. O3b and SES seek clarification from the Commission that this is the intent of the proposed rule.

2. In-Line Events with Later Entrants

In the NPRM, the Commission invites comment on how to "balance the competing interests of encouraging new market entry and providing NGSO FSS operators certainty with respect to a minimum amount of spectrum available for their services."[79] O3b and SES understand that a delicate balance must be struck between promoting additional competition and

[78] *See* NPRM ¶ 24.

[79] *See id.* ¶ 27.

protecting continuity of existing services.[80] As previously discussed, the upfront capital investment in space-related businesses is high and inherently riskier than in other kinds of communications-related ventures. NGSO FSS operators need to be able to provide investors with an element of certainty that their investments will not be stranded because of later entrants.

The Commission can strike a proper balance by ensuring that later NGSO FSS entrants to the Ka-band are required to protect all previously licensed NGSO FSS systems in the event of an in-line interference event. Specifically, the Commission should require an applicant requesting authority after an initial processing round to protect existing NGSO FSS systems by ceasing operations on the commonly authorized spectrum and during an in-line event.[81] These restrictions would provide incumbents and their investors with the certainty needed to expand their operations and develop innovative services while minimizing interference risks.[82]

D. *Earth Station Limits*

O3b and SES support the Commission's proposal to adopt equivalent isotropically radiated power ("EIRP") limits for uplink transmissions in the newly proposed NGSO FSS bands. This is a necessary step to ensure that there is a common understanding between all parties about what emissions are expected from transmitting earth stations when considering in-line interference events between two or more NGSO FSS systems. This proposed rule goes

[80] *See id.*

[81] *See id.*

[82] *See, e.g., id.* (citing *Northrop Grumman License*, 24 FCC Rcd at 2353 ¶ 69; *Application of Virtual Geosatellite, LLC, for Authority to Launch and Operate a Global Fixed-Satellite Service System Employing Non-Geostationary Satellites in Sub-Geosynchronous Elliptical Orbits*, Order and Authorization, 21 FCC Rcd 14687, 14712 ¶ 91 (IB 2006)).

hand-in-hand with the in-line event rules in Section 25.261.[83] Without off-axis EIRP limits, there could be in-line interference events outside of the main-lobe of the antenna. It is important to maintain certainty that in-line events occur during main-lobe to main-lobe coupling and at no other times or angles. Furthermore, NGSO FSS operators would always have the flexibility to coordinate different operating levels or conditions amongst themselves should every party come to an agreement. The difficulties in reaching an agreement between a large number of parties, however, justify the need for fallback limits that ensure a common understanding of uplink interference from transmitting earth stations. The Companies also agree that NGSO FSS applicants should be required to certify that they will abide by these default power limits unless higher transmission levels are appropriately coordinated, if the Commission ultimately decides to adopt EIRP density limits for NGSO FSS uplink transmissions.[84]

The Commission also seeks comment on whether to adopt downlink power limits and earth station receive gain criteria to facilitate sharing among NGSO FSS systems.[85] While downlink limits ensure that the interference from NGSO satellites outside of a receive earth station's main-lobe are below a defined threshold, which helps define the interference term in a link budget, such limits are more difficult to define for time-varying systems. Furthermore, the effects of downlink interference could also depend on the performance of the receive earth station, its ability to reject interference outside the main-lobe and its proximity to an adjacent co-frequency earth station.

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[83] *See supra* Section IV.C.

[84] *See* NPRM ¶ 30.

[85] *See id*.

V. THE COMMISSION SHOULD MODIFY ITS MILESTONE PROPOSAL.

As the Commission correctly notes in the NPRM, the operation of every space station in an NGSO FSS system proponent's authorized constellation may not be necessary to provide the services proposed.[86] Nonetheless, under current rules, failure to successfully launch and operate every authorized space station within six years could result in the automatic termination of the NGSO FSS system's license or market access grant, as well as a forfeiture of a bond (of up to $5 million),[87] despite the licensee having spent hundreds of millions of dollars and provided service to potentially thousands (or hundreds of thousands) of end users.[88] This requirement is intended to "ensure timely provision of service, and to prevent 'warehousing' of spectrum and orbital resources."[89] Rather than extend an all-or-nothing requirement to next-generation NGSO FSS systems, the rules should balance the need to prevent warehousing against the need for flexibility in initiating service and completing build-out on a viable and sustainable timescale.

The revised milestone approach proposed in the NPRM, however, still would impose a rigid metric requiring NGSO FSS systems to launch and operate 75 percent of their authorized satellite constellation by the end of the sixth year after license grant.[90] NGSO FSS operators that fail to meet this milestone would be required to forfeit the bond and lose the right to launch and

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[86] *See id*. ¶ 32.

[87] As the Commission clarifies in a footnote, a licensee that fails to meet its milestone deadline may avoid the automatic termination provision by demonstrating that the failure was caused by circumstances beyond the licensee's control. *See id.* ¶ 32 n.80 (citing 47 C.F.R. §§ 25.161(a)(1), 25.117(e), 25.165(c)).

[88] *See id.* ¶ 31 & n.79 (citing 47 C.F.R. § 25.165(a)(1)).

[89] *See id*. ¶ 31 n.77.

[90] *See id*. ¶ 32.

operate any satellites not in orbit as of the milestone date.[91] The Commission proposed that operators that satisfy the first milestone be subject to a second milestone, which requires launch and operation of one hundred percent of the authorized constellation by the nine-year mark after the license grant.[92] Operators failing to complete their constellations by this second milestone date would similarly have the number of authorized space stations automatically reduced to the number deployed as of the second milestone date.

O3b and SES support the Commission's initiative to grant NGSO FSS operators greater flexibility with regard to system deployment, and its recognition that satellite deployment timelines can sometimes be beyond the licensee's control.[93] The Companies believe, however, that the Commission's proposed solution is unduly onerous and potentially detrimental to promoting investment in the NGSO FSS sector.[94] Additionally, it is worth noting that the issue of "bringing into use" ("BIU") an ITU filing for an NGSO FSS system is currently the subject of extensive international discussions.

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[91] *See id*. The Commission clarifies in a footnote that "[e]ven under this 'keep what you use' proposal," the Commission would "continue to terminate automatically the full license of a satellite system if no authorized space stations were functional in orbit as of the time of the milestone deadline." *See id*. ¶ 32 n.82 (citing 47 C.F.R. § 25.161(a)(1)).

[92] *See id*. ¶ 32. The Companies note that the text proposed for Section 26.164(b)(1) expressly states that the first milestone does not apply to replacement NGSO space stations, but does not make the same clarification as to the second milestone.

[93] Numerous satellite operators have recently encountered delays due to factors beyond the operators' control. *See, e.g.*, *Mexican Satellite Lost as Russian Rocket Fails After Launch*, THE WALL STREET JOURNAL (May 16, 2015), http://on.wsj.com/2m0mMuc; Stephen Clark, *Citing SpaceX Delays, Inmarsat Moves Satellite Launch from Falcon Heavy to Ariane 5*, Spaceflight Now (Dec. 9, 2016), http://bit.ly/2mnTVkE.

[94] *See* NPRM ¶ 32.

WRC-15 discussed this matter at its seventh plenary session[95] and recognized a lack of specific provisions in the ITU Radio Regulations but was not able to reach a conclusion on an appropriate framework. Hence, WRC-15 invited ITU-R to examine the possible development of regulatory provisions requiring additional milestones beyond those defined for NGSO FSS systems under RR Nos. 11.25 and 11.44.[96] This study may also consider the implications of the application of such milestones to NGSO FSS and MSS systems brought into use after WRC-15.

There is also substantial discussion ongoing about the minimum number of operating satellites required to bring an NGSO FSS constellation into use, ranging from the current Radiocommunication Bureau ("BR") practice—a single satellite—to much larger percentages of the declared constellation. The eventual approach must strike a balance between these two extremes: a single satellite is clearly not sufficient to adequately represent a constellation consisting of several hundred or even thousands of satellites, whereas a large percentage may be unnecessarily rigid and would unduly penalize larger constellations that successfully deliver innovative services that the world's citizens demand albeit with less satellites.[97]

Considering that holders of ITU satellite network filings currently have seven years to

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[95] *See* Minutes of Seventh Plenary Meeting on Friday, 20 November 2015, Document 504-E, ITU-R WRC15 Contribution 504 (Dec. 10, 2015), http://bit.ly/2lNVIhs (restricted to TIES users).

[96] *See* ITU, BR, Circular Letter CR/389, WRC-15 Decisions Included in the Minutes of Plenary Meetings, at 4 (Jan. 29, 2016).

[97] The Companies note that the Commission sought to eliminate administrative complexity when it amended the licensing and operating rules for satellite services to, among other things, "reduce burdens on applicants, licensees, and the Commission, facilitating more rapid and efficient deployment of satellite services to the public." *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713, 14715 ¶ 1 (2015). The Commission's NPRM proposal could be a step in the opposite direction if the metrics that are adopted are not reasonable.

BIU a filing (and additional time beyond seven years is currently under discussion for NGSO FSS systems), the Commission's proposal that NGSO FSS operators must launch and operate seventy-five percent of the authorized NGSO FSS constellation in six years is unduly burdensome. Such a hard cut-off (with a potential loss of a $5 million bond and the inability to continue building out the constellation as a result) will generate additional uncertainty that is not conducive to promoting investment in NGSO FSS constellations. Satellite investors value the certainty and predictability that comes with knowing that the operators to which they have committed resources will have the ability to deploy a sufficient number of satellites to implement their business plans. Unlike terrestrial operators, who can expand their networks incrementally (and therefore preserve capital) after assessing the customer demand generated following initial deployment, satellite providers must make significant outlays of capital years in advance to launch and operate a satellite before any level of network coverage is achieved.

Rather than the Commission's proposed seventy-five percent at six years and one hundred percent at nine years, O3b and SES instead propose the following milestone approach for NGSO FSS systems:

- *At six years after license grant*, thirty-three percent of the authorized constellation must be launched and operational with at least one operational satellite in each orbital plane of the authorized system in order to avoid forfeiting the bond and to be able to continue building out the constellation. If 33 percent is not built out at six years, the operator would forfeit the bond but may continue to build out the constellation for another three years. The total number of authorized satellites for the constellation would be scaled back to three times the number of satellites in orbit by the six-year mark.

- *At nine years after license grant*, seventy-five percent of the authorized constellation must be launched and operational, and at least one satellite must be operational in each orbital plane of the authorized system. If the seventy-five percent threshold is met at nine years, the operator will retain its authorization for one hundred percent of the licensed constellation, be released from the bond, and be able to continue launching and operating satellites to fulfill the constellation (not to exceed one hundred percent of the authorized satellites).

  If seventy-five percent of the authorized constellation has not been placed into orbit after nine years, the operator will forfeit the bond and have the number of authorized satellites in its system scaled back to the number of satellites in orbit at the time of the second milestone.

- *After satisfaction of all milestones*, licensees should be required to maintain at least seventy-five percent of their authorized constellation in orbit at all times and at least one operational satellite in each authorized orbital plane, or face punitive action by the Commission.

- *Punitive options available to the Commission.* License termination may not be an effective administrative option if a number of NGSO satellites are in orbit and operational. Among the punitive leverage points available to the Commission regarding partially launched but operational systems, or shrinking systems,[98] are to: (a) periodically scale back the authorized size of the constellation; (b) prohibit replacement of satellites to allow the system to phase out over time; (c) require operators to forfeit the bond; and/or

[98] *See* NPRM ¶ 33.

(d) impose additional surety bond requirements.

- Operators may always seek to modify their license and add more satellites in a new tranche, whether or not their systems have been scaled back or fully built out. The Commission may wish to limit a licensee's ability to increase the size of its constellation in the future when it has failed to meet milestones.
- Operators also retain the option to request authority from the Commission for fewer satellites in their applications than may be indicated in their ITU filing.

The above proposals are based on the experience of O3b since 2007 as a start-up company financing, building, launching and operating NGSO satellites, as well as on SES's decades of experience operating GSO satellites. The Companies believe this framework represents a reasonable approach to addressing the Commission's concern regarding "timely provision of service" and "prevent[ing] 'warehousing' of spectrum and orbital resources."[99]

SES and O3b do not advise tying the number of satellites launched and operational to a "substantial service" obligation.[100] Satellite service offerings vary widely, targeting a range of markets and applications, such that it would be difficult to identify useful common metrics for determining whether systems are meeting an agreed threshold service requirement. Such a subjective metric will simply inspire time-consuming debates on whether a level of service is "substantial" and for whom. Operators should be incentivized to apply for the number of

[99] *See id.* ¶ 31 n.77.

[100] In the wireless context, "substantial service" is defined as "service which is sound, favorable and substantially above a level of mediocre service which just might minimally warrant renewal." 47 C.F.R. § 27.14(a). A license that fails to meet this requirement forfeits its license. *Id.*

satellites that they envision they can launch and operate in a given regulatory period (*e.g.*, 6+3 years), not to expect the regulations to be conformed to their high hopes.

O3b and SES agree with the Commission's proposed clarification that NGSO replacement space stations are not subject to the separate milestone requirements in Section 25.164 of the Commission's rules.[101] Because the satellites are intended to replace existing operational satellites, there is no possibility or concern for spectrum warehousing. Thus, a bond requirement would serve no purpose.

VI. O3b AND SES SUPPORT ELIMINATION OF THE NGSO FSS GLOBAL COVERAGE REQUIREMENT.

O3b and SES support the Commission's proposal to eliminate the current requirement that NGSO FSS systems operating in the 10.7-14.5 GHz, 18.8-19.3 GHz, or 28.6-29.1 GHz bands be designed to enable service worldwide for at least 18 hours every day.[102] This requirement imposes an artificial regulatory constraint that hampers satellite design and innovation.[103] Eliminating this global coverage requirement will provide NGSO FSS operators with the flexibility they need to design systems to meet diverse and constantly changing customer and market needs.

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[101] *See* NPRM ¶ 34; 47 C.F.R. § 25.164.

[102] *See* NPRM ¶ 35.

[103] *See id.* (citing *The Establishment and Service of Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite in the Ku-band*, Report and Order, 17 FCC Rcd 7841, 7860 ¶ 64 (2002)). O3b, for example, obtained a waiver from this requirement because the Commission recognized that "there is a limit on the northernmost and southernmost latitudes that can be served by [O3b's] system" because of look angle constraints arising from the fact that O3b's system does not operate in an inclined orbit, but rather in an equatorial orbit." Market Access Grant ¶ 14. Other NGSO satellites that orbit the Earth near the plane of the equator may similarly be unable to provide service in high-latitude regions. *See* NPRM ¶ 35.

VII. SHARING OPTIONS ARE LIMITED FOR SATELLITE SERVICE DOWNLINK BANDS.

In the NPRM, the Commission notes that as "NGSO FSS systems deploy in different frequency bands, it is important to consider how these systems can share spectrum with other non-satellite systems."[104] O3b and SES commend the Commission for considering how low-latency broadband NGSO FSS systems[105] share spectrum with non-FSS systems. Service providers like O3b and SES advance the Commission's goals of bridging the current "digital divide"[106] and encouraging broadband deployment to underserved and unserved populations in a timely manner.[107]

O3b and SES have a history of success on the spectrum sharing front. Since its inception, O3b has shared parts of its operating spectrum with terrestrial fixed services in the United States and has successfully coordinated individually-licensed earth stations with terrestrial fixed operators across the country without a single complaint of harmful interference. Recently, portions of the satellite uplink band in the Ka-band have already been identified for 5G mobile

[104] *See* NPRM ¶ 17.

[105] For example, the O3b satellite system currently connects to earth stations on multiple government bases in the United States; the United States government also relies on satellite services abroad and must be able to test or operate satellite services in the Ka-band to train and prepare its troops for theater-like communications scenarios. In addition to completing most of its terminal testing in the United States, O3b also currently provides services to the National Oceanic and Atmospheric Agency's National Weather Service in Pago Pago, American Samoa; to a United States offshore oil rig customer; and to a global cruise company that ports in the United States. *See* Comments of O3b, GN Docket No. 16-245, at 3-5 (filed Sept. 6, 2016).

[106] Remarks of Ajit Pai, Chairman, FCC, at 2 (Jan. 24, 2017), http://bit.ly/2m04R71 ("One of the most significant things that I've seen during my time here is that there is a digital divide in this country—between those who can use cutting-edge communications services and those who do not. I believe one of our core priorities going forward should be to close that divide").

[107] *See* 47 U.S.C. § 1302(a) (noting that the Commission "shall encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans").

services or UMFUS technologies.[108] The frequencies discussed in this proceeding, however, comprise the satellite downlink band, which is much more susceptible to interference from terrestrial transmit services than the satellite uplink band. O3b and SES support practical approaches to sharing that promote growth and avoid disrupting existing services. However, the introduction of terrestrial mobile services in the spectrum discussed in this NPRM could neutralize the ability of FSS earth stations to receive satellite signals, and therefore to deploy services in these bands. Accordingly, the Companies would not support the consideration of terrestrial mobile services or mobile technologies in the spectrum identified in the NPRM at this time.

[108] *See generally Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016).

VIII. CONCLUSION

The Commission's spectrum allocation proposals, if adopted, will expand spectrum access for FSS operations and promote greater and more flexible use of spectrum resources. By adopting the amendments proposed by O3b and SES, the Commission can better encourage continued innovation and greater deployment of high-capacity satellite services.

Respectfully submitted,

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Attachment A

Proposed changes adapted from Appendices A and C of the NPRM are illustrated by bold and underlined text in the chart below. Proposed changes to the footnotes in Appendix C are indicated with strikeouts (for deletions) and underlined text (for additions).

Proposed Ka-band Plan[109]

17.7-20.2 GHz Band

U.S. Non-Fed. Allocation	FS FSS (↑) US271 US334	FS **FSS** (↓) NGXX2 NGXX3 US334 US519	FSS (↓) NGXX3 US139 US334	FSS (↓) US255 NG164 EESS & SRS (passive) US139 US254 US334	FSS (↓) NG165 US139 US334	FS FSS (↓) NG166 NGXX2 NGXX3 US334			FSS (↓) NGXX3 MSS (↓) 5.525 5.526 5.527 5.528 5.529 US334
Ka-band Plan	FS	FS **FSS** (↓)	GSO FSS (↓) ngso fss (↓)	GSO FSS (↓)	NGSO FSS (↓) gso fss (↓)	FS GSO FSS (↓) ngso fss (↓)	FS **GSO FSS** (↓) NGSO MSS FL(↓) **ngso fss(↓)**	FS GSO FSS (↓) ngso fss (↓)	GSO FSS (↓) ngso fss (↓)
Total MHz	100 MHz	500 MHz	300 MHz	200 MHz	500 MHz	100 MHz	200 MHz	100 MHz	500 MHz

17.7 17.8 18.3 18.6 18.8 19.3 19.4 19.6 19.7 20.2 GHz

[109] In these charts, capitalized acronyms indicate primary services, and lower-case acronyms indicate secondary services. The abbreviations used are as follows: Earth exploration-satellite service (EESS); feeder link (FL); fixed-satellite service (FSS); fixed service (FS); geostationary-satellite orbit (GSO); Local Multipoint Distribution Service (LMDS); mobile-satellite service (MSS); mobile service (MS); non-geostationary-satellite orbit (NGSO); space research service (SRS); and Upper Microwave Flexible Use Service (UMFUS). The "↑" symbol denotes the Earth-to-space direction for transmissions (uplink); the "↓" symbol denotes the space-to-Earth direction for transmissions (downlink).

27.5-30 GHz Band

U.S. Non-Fed. Allocation	FS FSS (↑) NGXX3 MS	FSS (↑) NG165 NGXX3		FS FSS (↑) NG166 MS	FSS (↑) NGXX3 NGXX4		FSS (↑) NGXX3 MSS (↑) 5.525 5.526 5.527 5.529 5.543
Ka-band Plan	UMFUS fss (↑)	GSO FSS (↑) ngso fss (↑)	NGSO FSS (↑) gso fss (↑)	LMDS **GSO FSS (↑)** NGSO MSS FL (↑) **ngso fss (↑)**	GSO FSS (↑) NGSO MSS FL (↑) **ngso fss (↑)**	GSO FSS (↑) ngso fss (↑)	GSO FSS (↑) ngso fss (↑)
Total MHz	850 MHz	250 MHz	500 MHz	150 MHz	50 MHz	200 MHz	500 MHz

27.5 28.35 28.6 29.1 29.25 29.3 29.5 30 GHz

Selected footnotes:

NG164 The use of the band 18.6-18.8 GHz by the fixed-satellite service (space-to-Earth) is limited to geostationary-satellite networks.

NG165 In the bands 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz (Earth-to-space), geostationary satellite networks in the fixed-satellite service shall not cause harmful interference to, or claim protection from, non-geostationary-satellite systems in the fixed-satellite service.

NG166 The use of the bands 19.4-19.6 GHz (space-to-Earth) and 29.1-29.25 GHz (Earth-to-space) by the fixed-satellite service is limited to

i. feeder links for non-geostationary-satellite systems in the mobile-satellite service using left-hand circular polarization in the 19.4-19.6 GHz band and right-hand circular polarization in the 29.1-29.25 GHz band, and

ii. geostationary satellite networks and non-geostationary satellite systems (not providing feeder links to the mobile-satellite service) using right-hand circular polarization in the 19.4-19.6 GHz band and left-hand circular polarization in the 29.1-29.25 GHz band. Non-geostationary satellite systems in the fixed-satellite service (not providing feeder links to the mobile-satellite service) shall not cause unacceptable interference to, or claim protection from, geostationary-satellite networks in the fixed-satellite service.

NGXX1 The use of the bands 10.7-11.7 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) by non-geostationary-satellite systems in the fixed-satellite service is limited to communications with individually licensed earth stations.

NGXX2 The use of the bands 17.8-18.3 GHz, 19.3-19.4 GHz, and 19.6-19.7 GHz by the fixed-satellite service (space-to-Earth) on a co-primary basis with the fixed service is limited to communications with individually licensed earth stations. Ubiquitously deployed user terminals may be deployed on a secondary basis with respect to the fixed service ~~are not permitted~~.

NGXX3 In the bands 17.8-18.6 GHz (space-to-Earth), 19.3-19.4 GHz (space-to-Earth), 19.6-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), and 29.3-30 GHz (Earth-to-space), non-geostationary satellite systems in the fixed-satellite service shall not cause unacceptable interference to, or claim protection from, geostationary-satellite networks in the fixed-satellite service.
A non-geostationary-satellite system operating within the applicable equivalent power flux-density limits set forth in § 25.208 of this chapter shall not be considered to cause unacceptable interference to any geostationary-satellite network in the fixed-satellite service.

NGXX4 The use of the band 29.25-29.3 GHz by the fixed-satellite service (Earth-to-space) is limited to

i. geostationary-satellite networks and
ii. feeder links for non-geostationary-satellite systems in the mobile-satellite service using right-hand circular polarization, and
iii. non-geostationary satellite systems (not providing feeder links to the mobile-satellite service) using left-hand circular polarization. Non-geostationary satellite systems in the fixed-satellite service (not providing feeder links to the mobile-satellite service) shall not cause unacceptable interference to, or claim protection from, geostationary-satellite networks in the fixed-satellite service.

US139 Fixed stations authorized in the band 18.3-19.3 GHz under the provisions of 47 CFR 74.502(c), 74.602(g), 78.18(a)(4), and 101.147(r) may continue operations consistent with the provisions of those sections.

US271 The use of the band 17.3-17.8 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for broadcasting-satellite service.

US519 The band 18-18.3 GHz is also allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. Its use is limited to geostationary satellites and shall be in accordance with the provisions of Article 21, Table 21-4 of the ITU *Radio Regulations*.